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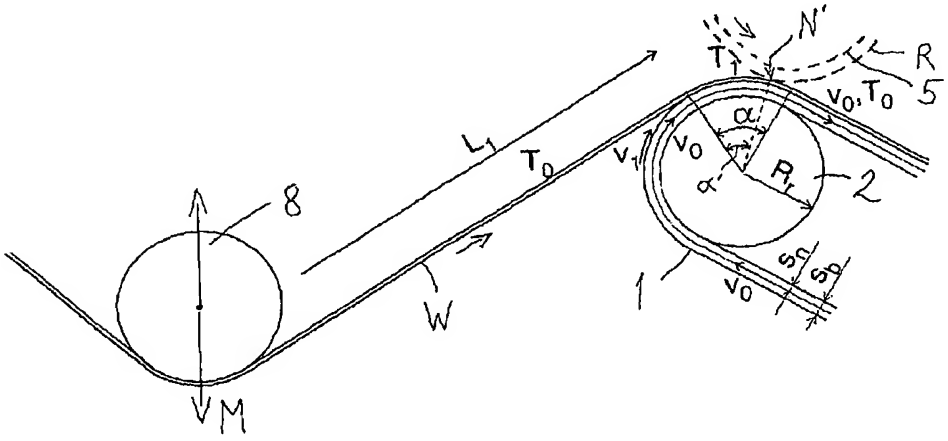
(54) Title: A METHOD AND A DEVICE FOR GUIDING A WEB



(57) Abstract: In a reeling process a paper web is continuously reeled into reels around rotating reeling cores in such a manner that the web (W) is guided into a reel (R) around a reeling core (5) through a reeling nip between a loop of an endless supporting member (1) and the reel (R), at least in some stage the reeling core (5) is transferred in relation to the loop of the supporting member (1) according to the growth of the diameter of the reel (R) in such a manner that the position of said reeling nip (N) moves forward on the web-carrying portion of the endless supporting member (1) in the travel direction of said portion. The wrap angle (α) of the web (W) at the location of the first guiding roll (2) of the loop of the endless supporting member (1) and at the same time the web tension of the web at the location of the first guiding roll (2) is controlled by means of a web guiding roll (8) preceding the loop in the travel direction of the web (W).

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A method and a device for guiding a web

The invention relates to a method for guiding a web, which is of the type presented in the preamble of the appended claim 1. The invention also relates to a device which is of the type presented in the preamble of the appended claim 10.

In the final end of a paper machine or a finishing apparatus for paper, a typically several meters wide paper web, which has been produced and/or treated in earlier machine sections, is reeled around a reel spool to form a machine reel. In this reeling up process a reeling cylinder that is journalled rotatable is typically used for guiding the paper web on the machine reel, wherein the nip contact between the reeling cylinder and the machine reel is utilized to influence the quality of the reel produced thereby. In a conventional solution the reeling cylinder remains stationary and the reel spool around which the reel is accumulated in nip contact is moved during reeling up in a supporting structure, for example by supporting the ends of the reel spool on reeling rails. The ends of the reel spool are affected by means of a suitable loading mechanism to adjust the nip contact between the machine reel that is being formed and the reeling cylinder. Such reeling concepts and loading methods related thereto are disclosed, for example, in the Finnish patent 91383 and in the corresponding US patent 5,251,835, as well as in the Finnish patent application 950274 and in the corresponding US patent 5,690,298.

Another known solution is the one in which the reeling cylinder is arranged to move on a carriage, and the machine reel is rotated with a center drive in a stationary reeling station, i.e. location of the center of the reel spool remains the same. When the radius of the machine reel grows, the reeling cylinder shifts in such a manner that the carriage supporting the same moves in the guide. Such an arrangement is disclosed, for example, in the European application publication 792829 and in the corresponding US patent 5,988,557.

US patent 5,370,327 discloses a solution in which the reeling cylinder moves in the vertical direction, thus making it possible to maintain the

angular position of the nip between the reeling cylinder and the machine reel constant when the reel moves on the reeling rails. The low position of the reeling cylinder and the movement of the same in the vertical direction enable the transfer of the reel spools from a storage to a reeling station along a straight transfer path. The solution contains two pairs of reeling carriages, of which the pair that has delivered the full machine reel can return past the other pair that is guiding the reel to be reeled, to retrieve a new empty reel spool.

According to the Finnish patent application 950274 and the corresponding US patent 5,690,298 it is possible to use an auxiliary roll located at a lower position and moving in the vertical direction in addition to the stationary reeling cylinder that guides the web on the reel, said auxiliary roll forming a second nip with the machine reel produced in the moving reeling station. Before the change this auxiliary roll is in contact with the reel that is becoming full, which has been run off the reeling cylinder. A corresponding arrangement in connection with a change is disclosed in the Finnish patent 91383/ US patent 5,251,835.

In addition, the publication EP-860391 discloses a reeler, in which the web is guided on a reel via a belt or a wire, which is led via guiding rolls. Thus, by means of the belt or the wire, a long reeling nip having an even pressure is provided on the area of the lower half of the reel. The pressure can be adjusted through the tension of the belt or the wire. The belt or wire loop can be tilted in the vertical plane in such a manner that the first guiding roll in the travel direction of the web can be lifted against the new reel spool, which rests on reeling rails above the belt. When the reel grows it moves forward on the reeling rails in such a manner that it is constantly in contact with the downwards-tilted run of the wire or belt, which follows the guiding roll and via which the web comes on the reel.

Furthermore, the patent US-5531396 discloses a reeler, in which the wire loop is guided over the reeling cylinder in such a manner that it guides the web after the reeling cylinder on the reel that is being formed.

In reelers utilizing a wire or a belt, problems are caused by the process of bringing the web on the wire or belt loop. As disclosed in the aforementioned publication EP-860391, the web is brought to the loop at a point where the wire or the belt curves on top of the first guiding roll. The central angle of the curve along which the web travels under the guidance of the guiding roll before moving on the straight section of the loop leading to the reel, can be called a wrap angle. Thus, the wrap angle is the angle of the sector wrapped by the web when it travels on the curved section of the wire or the belt. The publication EP-860391 shows that the belt enters the loop under the guidance of the guiding roll preceding the same in such a manner that the wrap angle is over 90°. In reelers using a wire or belt loop, problems are caused by the speed differences on the outer surface of the loop, caused by the curving of the loop at the location of the guiding roll. In a belt-like material of certain thickness it is possible to determine a so-called neutral axis that always travels at the same speed irrespective of the curvature of the travel path of the belt. Within the curved section at the location of the guiding roll, the outer surface located outermost in the direction of the radius of the guiding roll travels faster than the neutral axis, whereas within the straight section following thereafter, the speeds of the outer surface and the neutral axis are the same. At large wrap angles the tension of the web increases at the location of the guiding roll due to the higher surface speed, which can cause slackening or even bag formation in the straight section following the guiding roll. This causes problems in the control of reeling, because the increase in tension must be taken into account in the tension control.

It is an aim of the invention to present a new method utilizing a belt or a wire to guide the web in a reeler, which method does not have the problems caused by temporary tensioning, and the reeling parameters can be selected according to the desired quality of the reel. To attain this purpose, the method according to the invention is primarily characterized in what will be presented in the characterizing part of the appended claim 1. The wrap angle at the location of the first guiding roll inside the loop and at the same time the tension of the web is controlled by means of a movable web guiding roll, whose location deter-

mines the inlet angle of the web to the loop and correspondingly the wrap angle in the wire or belt travelling around the guiding roll.

The web guiding roll is located immediately before the loop in such a manner that the web travels directly from its periphery to the loop. The web guiding roll is located advantageously on the same side of the web than the outer surface of the loop conveying the web, wherein it is at the same time possible to prevent the access of air between the outer surface of the loop and the web.

As for the other embodiments of the invention and their advantages, reference is made to the appended dependent claims and to the description hereinbelow.

In the following, the invention will be described in more detail with reference to the appended drawings, in which

Fig. 1 illustrates schematically the main principle of the method in the reeling up process in a side view of the reeler,

Fig. 2 illustrates the behaviour of the web when it comes to the loop,

Fig. 3 illustrates the method according to the invention in a side-view of the reeler, and

Fig. 4 shows in a top view one possible way of performing the reeling.

Fig. 1 illustrates a continuously operating reel-up, where a paper web W, which is normally several meters wide and comes from a preceding section of a paper machine or a finishing apparatus for paper, travels via a reeling nip N to a reel R. The reeling nip is formed by means of a flexible supporting member 1 in the form of an endless loop, such as a belt or a wire. The supporting member 1 is guided via two guiding rolls 2 and 3, at the location of each of which the run of the member 1 turns to the opposite direction. In the travel direction of the web the first

guiding roll 2 can form a "hard nip" with the reel being started at the initial stage of the reeling in such a manner that the supporting member 1 is in contact with the reel at a point where the member travels supported by the guiding roll 2 over the surface of the roll. The second guiding roll 3 or the first guiding roll 2 can be a driven roll, i.e. a traction roll, or separate drives can be arranged for both rolls. Advantageously only the second roll is a traction roll, wherein the section of the loop of the supporting member 1 guiding the web and forming a nip with the reel is tighter.

The web travels guided by the supporting member 1 onto the machine reel R, which is formed around a reel spool 5 rotatable with its own center drive. It is possible for the reel spool 5 to move in the machine direction with respect to the loop of the supporting member 1, and this is arranged in such a manner that the bearing housings at the ends of the reel spool that enable the rotation of the reel spool 2 are supported on suitable supporting structures. In connection with the reeler, there is also a storage of empty reel spools 5 (not shown), from where the rolls are brought to the change station at the first guiding roll 2 in order to change the web going to the machine reel R that is becoming full. The reel change takes place at production speed, i.e. the paper web 1 passed at high speed to the full reel is changed to travel onto a new reel spool brought to the change station, said reel spool being rotated with a center drive of its own at peripheral speed corresponding to this speed.

The machine reel R can be transferred in the machine direction in a transfer device 7, which supports the bearing housings at the ends of the reel spool and which is moved by means of actuators attached to the frame of the reeler. The transfer device 7 is arranged to move on substantially horizontal reeling rails 6 extending in the machine direction, and it is formed of a carriage at each end of the reel spool, which supports the bearing housing at the end of the reel spool 5. When the diameter of the machine reel R grows, and the reel moves forward, it is in continuous contact with the supporting member 1 because the transfer path of the transfer device 7 and the web-carrying portion of the supporting member 1 together form an angle opening in the trans-

fer direction. In Fig. 1, the upper web-carrying portion of the loop of the supporting member 1 is directed diagonally downwards in its direction of movement, whereas the transfer path of the reel R (and the reel spool 5) is substantially horizontal.

The transfer device 7 is transferred forward along the reeling rails 6 in the travel direction of the web 1 in accordance with the growth of the diameter of the reel R so that the reel is, at its lower side, always in contact with the loop of the supporting member 1 in such a manner that the web moves over to the outer periphery of the reel R in the reeling nip N between the web-carrying portion of the loop and said outer periphery. Thus, the reeling nip N moves continuously forward in accordance with the growth of the reel in the travel direction of the upper portion of the loop. When the reel R becomes full, the reel spool 5 forming the core of the reel is brought to the change station and the web is changed to travel around the same at the production speed. The full reel R is removed from the transfer device 7, and the transfer device is moved back to the initial end of the portion of the loop carrying the web, and the new reel spool 5 around which a new web has started to accumulate after the change is delivered thereto from the initial reeling station.

Fig. 2 illustrates the factors affecting the behaviour of the web at the loop of the supporting member 1. Before the loop of the supporting member there is a web guiding roll 8 whose location determines the entry point of the web W to the loop, i.e. the web travels in a straight form to the curved section of the loop that is formed because of the web guiding roll 2. As seen from the side, the straight section of the web thus coincides with the tangent common to the periphery of the web guiding roll 2 and the arc of the loop.

Fig. 2 shows the web tension in the machine direction (MD) at different points as well as the factors affecting the same. In the figure the arrival of the web W to the loop is guided by a web guiding roll 8 from whose periphery the web travels directly on that section of the loop of the supporting member 1 that curves on top of the peripheral surface of the first guiding roll 2. In the following discussion the term belt will be used

for the supporting member 1. The phenomena that will be discussed hereafter, take place in all planar flexible supporting members passed around the guiding roll 2 and having a certain thickness.

In Fig. 2 the markings have the following meanings:

v_0 = speed of the neutral axis of the belt (and the surface speed of the belt at the straight section) [m/s],

v_1 = surface speed of the belt at the curved section (at the location of the roll) [m/s],

R_r = radius of the belt guiding roll [m],

s_b = thickness of the belt [m],

s_n = distance of the neutral axis of the belt from the inner surface of the belt [m],

α = wrap angle (rad),

T_0 = tension of the web at the straight section [N/m],

T_1 = maximum tension of the web at the curved section of the belt [N/m], and

L_1 = web length from the preceding hold point to the belt [m].

Let us assume that in an ideal situation the web speed of the paper web W in the straight section of the belt is equal to the speed of the neutral axis of the belt (and the surface speed of the belt in the straight section) v_0.

The hold point is the preceding point of the web transfer in which there exists holding between the web and the member drawing the web. Typically such hold points include dryer and drive groups and grooved rolls. In this case the web guiding roll 8 constitutes such a hold point.

The figure shows that the surface speed at the location of the roll 2 is:

$$v_1 = \frac{R_r + S_b}{R_r + S_n} \times v_0 \qquad (1)$$

The increase in the tension of the web can be described with the following equation:

$$\Delta T = T_1 - T_0 = \varepsilon \cdot E \cdot (1 - e^{-t/\tau}), \qquad (2)$$

in which
ε = relative elongation,
E = modulus of elasticity of the web [N/m],
t = effective duration (the time the web is against the curved section of the belt) [s], and
τ = time constant (the time during which the web travels from the preceding hold point to the belt) [s].

The relative elongation ε resulting from the speed differences is obtained simply by dividing the increase in speed $v_1 - v_0$ with the original speed v_0.

Thus, the time constant τ is calculated from the preceding figure with the formula L_1/v_0.

On the basis of the preceding formula (2) it can be stated that the longer the web is positioned against the curved section of the belt, the more the tension is increased. Calculatorily it can be shown that the constant $-t/\tau$ is obtained in the following manner:

$$-t/\tau = -\frac{\alpha \cdot (R_r + s_b)}{v_0} \cdot \frac{v_0}{L_1} = \frac{\alpha \cdot (R_r + s_b)}{L_1} \qquad (3)$$

This shows that by adjusting the wrap angle α of the web on top of the first guiding roll 2, it is at the same time possible to adjust the increase in the tension of the web ΔT over the curved section of the belt. Correspondingly, when the wrap angle α of the web on top of the first guiding roll 2 is kept constant, the increase in the tension of the web ΔT in the curved section of the belt remains constant. The formula (3) also shows the same fact already shown in Fig. 2, i.e. when the wrap angle α of the web is zero, the increase in the tension of the web ΔT is also zero.

Furthermore, by means of calculations it is possible to show that the tension can never increase in the curved section of the belt beyond the hold between the belt and the web. If the increase in tension exceeds the hold, the paper starts slipping on top of the belt, and the increase in tension ΔT is equal to the hold. It is, in fact, possible to calculate that the average normal force/width meter exerted by the web against the curved section of the belt is

$$F_N = (\alpha / 2\pi) (T_0 + T_1)/2$$

where F_N = the normal force [N/m],

The hold between the web and the belt is obtained in the following manner.

$$F_\mu = \mu F_N = \mu (\alpha / 2\pi) (T_0 + T_1)/2$$

where μ = friction coefficient

The other markings are equal to those presented hereinabove.

When running at a constant web tension, it is possible to adjust the increase in the tension of the web ΔT over the curved section of the belt by adjusting the wrap angle α of the web on top of the first guiding roll 2, because the increase in the tension ΔT cannot exceed the hold F_μ.

In Figs 1 and 2 the arrow M illustrates the possibility of moving the web guiding roll 8 in relation to the loop of the supporting member in such a manner that the entry point of the web on top of the supporting member and correspondingly the wrap angle α change. Thus, the guiding roll 8 is moved in relation to the first guiding roll 2 located inside the loop. For this purpose the web guiding roll 8 can be arranged in the frame of the reeler to be moved for example substantially in the vertical direction along a linear path.

Figure 3 shows another alternative. It illustrates the possibility of changing the position of the loop of the supporting member 1 in the vertical direction for example in such a manner that the first guiding roll 2 can be located in different height positions. The turning point can be

another guiding roll, for example according to the solution disclosed in the publication EP-860391. Here, the guiding roll 8 defining the wrap angle α is mechanically coupled to the loop of the supporting member in such a manner that it moves when the loop is moved, but its position remains constant with respect to the run of the loop of the supporting member, in other words the straight line between axes of the web guiding roll 8 and the first guiding roll 2 of the loop is always at the same angle with respect to the straight line between the first guiding roll 2 and the second guiding roll 3. In Fig. 3 the wrap angle is illustrated by means of the angle between the extension of the straight section of the loop of the supporting member 1 and the straight section of the web preceding the loop, which according to the laws of geometry corresponds to the wrap angle α in magnitude.

In the alternative of Fig. 3 it is also possible to arrange the web guiding roll 8 in such a manner that its position can be adjusted with respect to the loop of the supporting member 1, although it is kinetically coupled to the loop of the supporting member in such a manner that it moves along with the movement of the loop. Thus, the web guiding roll 8 can be arranged pivotable for example in the vertical plane on the frame of the loop, and the entire loop can be transferred by moving said frame. It is possible to arrange actuators between the swinging arms, supporting the web guiding roll, and the frame of the loop, by means of which actuators this pivotal movement can be attained.

When the wrap angle α can be adjusted or kept constant, the increase in tension at the location of the guiding roll 2 is known, and it can be taken into account when selecting the reeling parameters. Advantageously the aim is to keep the wrap angle under 90°, more advantageously under 45°. When the magnitude of the wrap angle is adjusted, the aim is to change it in such a manner that its value remains below said maximum values α_{max}. The wrap angle is advantageously always larger than 0, also in such a case where the aim is to arrange it as small as possible to avoid fluttering problems of the web and allow the transfer of web from its free section to the supporting member 1 (the belt) to take place in a controlled manner. To minimize the increase in tension it may be advantageous to keep the wrap angle under 20°

and/or to change its magnitude while it is kept below this maximum value α_{max}. The wrap angle that can be adjusted or kept in a certain constant value is advantageous especially in methods in which the reel spool 5 is center-driven, and the tension of the web layers of the reel R thus produced is influenced by adjusting the web tension in the section of the web immediately preceding the loop and/or by adjusting the torque (winding force) of the center drive.

The adjustment of the wrap angle is especially significant in such a case where the reeling nip N' is located in the curved section of the supporting member 1, i.e. the reel is located at the guiding roll 2, thus forming a so-called "hard" nip. This situation that can occur during the initial reeling is illustrated by means of a broken line in Fig. 2. In the figure the web travels in the curved section before the nip N' in a sector smaller than the wrap angle α of a normal situation. By adjusting the magnitude of the wrap angle α' located before the nip N' and corresponding to the aforementioned sector it is possible to affect the tension of the web W travelling to the reel. For example by changing the position of the web guiding roll 8 with respect to the guiding roll 2, it is possible to set the wrap angle α' to the desired value for initial reeling, or in general for a situation where the nip N' between the reel and the supporting member is located at that point where the supporting member is positioned against the shell of the guiding roll 2. As the reeling process proceeds, the reeling nip moves on to the straight section of the loop, in which the reeling proceeds according to the stages presented hereinabove in connection with Fig. 1.

Yet another possible parameter is the tension of the loop of the supporting member 1 itself. However, this does not have any effect on the web tension, but it can be utilized to affect the radial force between the peripheral surface of the reel and the outer surface of the loop in the reeling nip N, i.e. the nip load. In the method according to the invention this feature is also advantageously used as one adjustable parameter. The tension of the supporting member can be adjusted for example by means of a tension roll that is in contact with the loop.

Fig. 4 shows an advantageous way of further improving the reeling in the reeler type shown in the figure. This is a reeling process with a supporting member 1 narrower than the web width, such as a wire. Previously it has been known to reel the web onto a reel with a supporting member wider than the web width and the reel width. In this case the edges of the supporting member do not stretch as much as the supporting member in the web area during the reeling. At the edge of the reel, the upward turned edge of the supporting member loads the edge of the reel inward on the straight section of the loop, thus preventing the exit of air from the reel. Furthermore, the supporting member wears unevenly, which may cause creasing and even prevent the reeling at different trim widths when the same supporting member is used.

When the supporting member 1 is narrower than the web W to be reeled and the reel R, the aforementioned problems are eliminated. The outer edges of the supporting member are located inside the end edges of the reel R, and they do not hinder the exit of air from the reel. The supporting member is in contact with the web and the reel within its entire width, and uneven wearing does not occur. If different trim widths are used, the width of the supporting member 1, such as a wire, is dimesioned so that it is narrower than the minimum web width.

The solution of Fig. 4 is well suited to be used in connection with tension control, because by affecting the wrap angle in all ways shown in Figs 1 to 3 it is at the same time possible to affect the tension difference between the portion of the web positioned against the supporting member 1 and the edges of the web remaining outside the supporting member 1 at the location of the web guiding roll 2. The solution of Fig. 4 can also be applied in such reeler types according to Fig. 1, in which there is no web tension control by means of a web guiding roll preceding the loop of the supporting member.

The invention is not restricted to the embodiments described above, but it can be modified within the scope of the inventive idea presented in the claims.

The planar flexible supporting member 1, which forms a closed loop by means of two or more rolls, is advantageously air permeable, for example a wire. However, such supporting members that are air impermeable also fall within the scope of the invention, for example belts having a closed surface. The supporting member is of the same structure in the lateral direction of the machine, i.e. it corresponds to the width of the web being reeled. However, the idea that the loop is formed of several in parallel next to each other travelling loops also falls within the scope of the invention, while the general geometry from the side-view is exactly the same as in Figs. 1 to 3, wherein adjacent loops cover the web width and travel around common guiding rolls 2 and 3. Thus, the tension of the loops can, for example, be adjusted independently according to the principles known from the publication EP-860391. However, the tension behaviour of the web at the location of the guiding roll 2 is also in this case influenced by the same factors as in Fig. 2.

The wrap angle α can also be changed in other ways besides changing its magnitude. For example, when the supporting member is pressed down under the effect of the reel R, it is possible to compensate the increase in the magnitude of the wrap angle, caused by this pressing, at the location of the first guiding roll 2 by moving the web guiding roll 8. Thus, the magnitude of the wrap angle can be kept the same, but the sector in which it is located is shifted with respect to the roll 2.

The movements of the loop in Fig. 3 can also be of other type, for example both guiding rolls 2 and 3 can also be transferred simultaneously. Similarly, it can be thought that the web guiding roll 8 can be transferred in the travel direction of the web in such a manner that the length L_1 of the straight web section between said web guiding roll and the guiding roll 2 can be transferred.

Claims:

1. A method in reeling, where a paper web is continuously reeled into reels around rotating reeling cores in such a manner that

— the web (W) is guided into a reel (R) around a reeling core (5) through a reeling nip between a loop of an endless supporting member (1) and the reel (R), and

— at least in some stage the reeling core (5) is transferred in relation to the loop of the supporting member (1) according to the growth of the diameter of the reel (R) in such a manner that the position of said reeling nip (N) moves forward on the web-carrying portion of the endless supporting member (1) in the travel direction of said portion,

characterized in that the wrap angle (α) of the web (W) at the location of the first guiding roll (2) of the loop of the endless supporting member (1) and at the same time the web tension of the web at the location of the first guiding roll (2) is controlled by means of a web guiding roll (8) preceding the loop in the travel direction of the web (W).

2. The method according to claim 1, **characterized** in that the web guiding roll (8) is transferred with respect to the loop of the supporting member (1) in such a manner that the wrap angle (α) changes.

3. The method according to claim 2, **characterized** in that the web guiding roll (8) is transferred with respect to the loop of the supporting member (1) in such a manner that the entry point of the web changes at the loop of the supporting member.

4. The method according to claim 1, **characterized** in that the web guiding roll (8) is transferred along with the loop of the supporting member (1) in such a manner that the wrap angle (α) remains substantially the same.

5. The method according to any of the preceding claims, **characterized** in that the access of air between the web (W) and the loop of

the supporting member (1) is prevented by positioning the web guiding roll (8) on the same side of the web with the loop.

6. The method according to any of the preceding claims, **characterized** in that the wrap angle (α) is adjusted under 90° (α_{max}) in magnitude.

7. The method according to claim 6, **characterized** in that the wrap angle (α) is adjusted under 45° (α_{max}) in magnitude.

8. The method according to claim 7, **characterized** in that the wrap angle (α) is adjusted under 20° (α_{max}) in magnitude.

9. The method according to any of the preceding claims, **characterized** in that the supporting member (1) is narrower than the web width of the web to be reeled.

10. A device for guiding a web in a reel-up, which is arranged to continuously reel a paper web into reels around rotating reeling cores, comprising

— a transfer device (7) for transferring the reeling core (5) and the reel (R) forming around it during reeling, where the paper web (W) is guided continuously to the reel (R) through a reeling nip (N),

— a loop formed by an endless supporting member (1), comprising a web-carrying portion, which forms a reeling nip (N), wherein the transfer device (7) is arranged to transfer the reel in the reeling so that said reeling nip (N) moves in the travel direction of the web-carrying portion,

— a first guiding roll (2) inside the loop, which roll is located in the travel direction of the supporting member (1) in the beginning of the web-carrying portion forming the reeling nip (N),

characterized in that the device for guiding the web comprises a web guiding roll (8) preceding the loop in the travel direction of the web, said web guiding roll being arranged movable to control the wrap angle (α) of the web at the location of the guiding roll (2).

11. The device according to claim 10, **characterized** in that the web guiding roll (8) is arranged to be transferred with respect to the loop in such a manner that the wrap angle (α) changes.

12. The device according to claim 10, **characterized** in that the web guiding roll (8) is coupled to the loop to be transferred together with the loop.

13. The device according to any of the preceding claims 10 to 12, **characterized** in that the web guiding roll (8) is positioned on the same side of the web with the loop of the supporting member (1).

14. The device according to any of the preceding claims 10 to 13, **characterized** in that the web guiding roll (8) can be moved with respect to the loop or it is placed with respect to the first guiding roll (2) in such a position that the wrap angle (α) is under 90° (α_{max}).

15. The device according to claim 14, **characterized** in that the web guiding roll (8) can be moved with respect to the loop or it is placed with respect to the first guiding roll (2) in such a position that the wrap angle (α) is under 45° (α_{max}).

16. The device according to claim 15, **characterized** in that the web guiding roll (8) can be moved with respect to the loop or it is placed with respect to the first guiding roll (2) in such a position that the wrap angle (α) is under 20° (α_{max}).

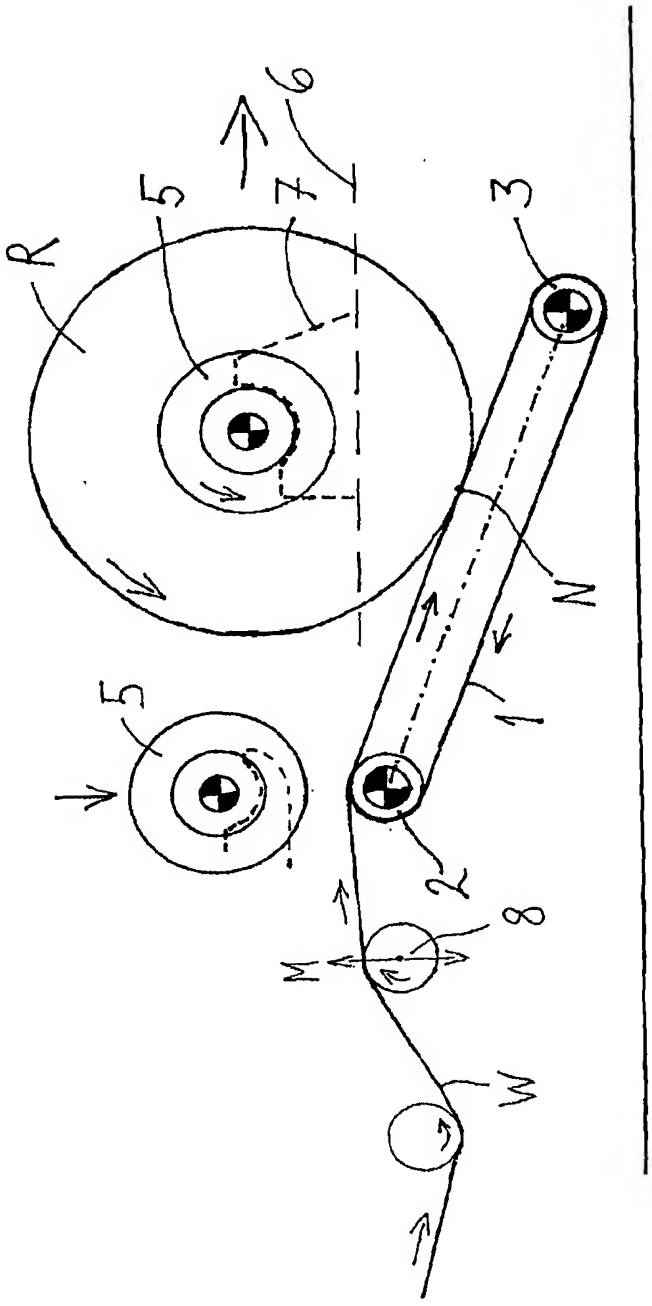

Fig. 1

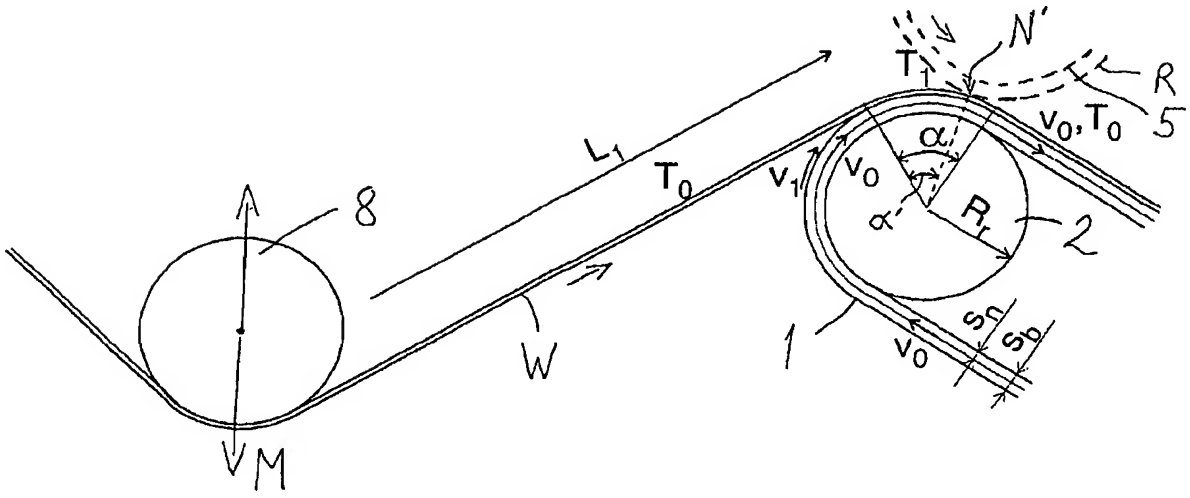

Fig. 2

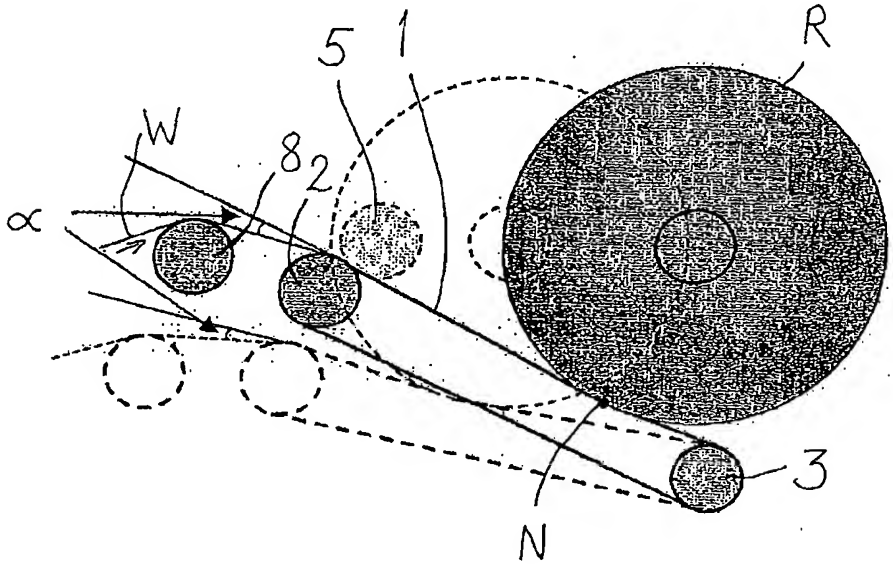

Fig. 3

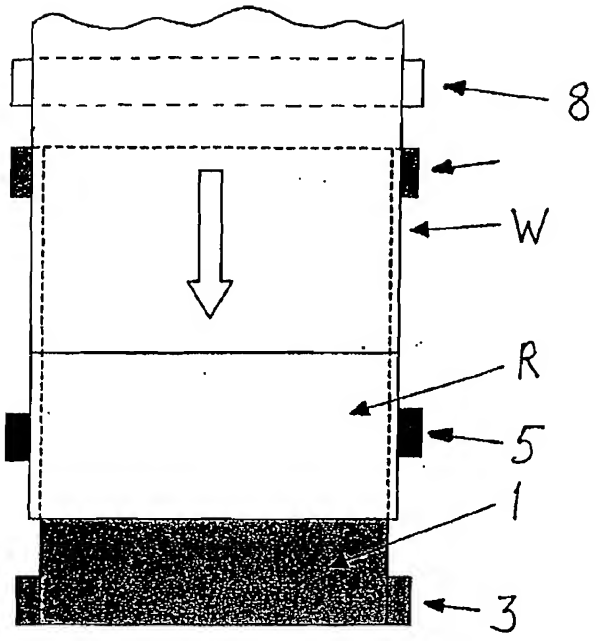

Fig. 4

INTERNATIONAL SEARCH REPORT

Intern al Application No
PCT/FI2004/050186

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B65H18/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B65H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 944 273 A (LIN ET AL) 31 August 1999 (1999-08-31) column 8, line 35, paragraph 9 - column 9, line 7; figures 2,3	1,10
A	US 4 283 023 A (BRAUN ET AL) 11 August 1981 (1981-08-11) the whole document	1,10
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A	US 4 143 828 A (BRAUN ET AL) 13 March 1979 (1979-03-13) the whole document	1,10

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
30 March 2005	13/04/2005

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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